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CHANGING COMPARATIVE ADVANTAGE IN PHILIPPINE RICE PRODUCTION

by

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ABSTRACT

This paper examines Philippine comparative advantage in rice production and whether government policies encourage the rice sector to exploit its advantage.

Rice production has grown at 6.0 percent annually in 1970s. This growth has been due to yield increases from newer modern varieties and more fertilizer and to increases in irrigated area. Government policies have contributed to growth principally through irrigation investments.

Irrigation is heavily subsidized but other price policies tax producers. Domestic rice prices are slightly below world prices and most input prices are above world levels. The distortion in net incentives however is not large. The net effect of government policy is to provide slightly positive protection for irrigated farms (3.6%) and slightly negative protection for rainfed farms (-4.7%).

Rice production on both rainfed and irrigated environments is socially profitable in 1979. Although yields are higher on irrigated fields costs per unit of rice output are similar in rainfed systems. Government policies reduce private profitability in rainfed farms, but in social terms these farms are quite competitive. A comparison of the DRC for irrigated rice with the 1974 estimate of Herdt and Lacsina (1976) shows that rising yields have increased Philippine comparative advantage in rice. Future comparative advantage will depend on the relative growth of yields and irrigation costs. If capital cost per new hectare irrigated continues to grow at past rates, yields will have to increase at least 2.8 percent annually to maintain current comparative advantage.

Although the Philippines has a comparative advantage in rice production, exports were unprofitable for the government marketing agency in 1977 to 1979. Government control of exports puts a barrier between world and domestic markets so that world quality premiums are not reflected in domestic prices. The domestic milling industry therefore has no incentive to become competitive in higher quality international markets. Inelastic demand for low-quality Philippine rice on world markets then limits profitable exports. If private traders were allowed to export, they should be able to respond to world market incentives to produce and export good quality rice at a profit.

CHANGING COMPARATIVE ADVANTAGE IN PHILIPPINE RICE PRODUCTION*

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Philippine rice production has grown remarkably in the last fifteen years. Production grew at an average annual rate of 5.3 percent between 1965 and 1980 and total production doubled from 2.5 million to 5.0 million tons of milled rice. Growth in supply has overtaken growth in demand so that the Philippines had exportable surpluses and constant real rice prices between 1977 and 1982.

Philippine rice policy in the 1960s and early 1970s focused on buffering consumers from fluctuations in production and world prices. Government efforts to promote production were prompted by crop failures and rising world prices in the early 1970s. Success in reaching domestic self-sufficiency in the late 1970s raises a new policy issue. Can the Philippines export rice profitably? The answer to this question depends on whether the Philippines has a comparative advantage in rice production and whether government policies will encourage the rice sector to exploit that advantage.

This paper examines the evidence regarding Philippine comparative advantage in rice production. It begins with a review of the sources of growth in production. An examination of the impact of government policies on incentives and past growth in rice production follows. Then current social costs and returns in rice production are measured with data from the IRRI 1979 wet season survey of 149 Central Luzon farmers. Social profitability is estimated for eight rice farming systems classified by type of cropland, i.e.

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rainfed, one-crop irrigated, and two-crop irrigated, and by source of power in land preparation and threshing. Herdt and Lacsina (1976) measured social profitability in Philippine rice production in 1974. A comparison of their 1974 results with our findings shows that comparative advantage has increased due to technical change and provides some indication about the future determinants of Philippine comparative advantage in rice.

Past Trends in Production, Trade, and Government Market Intervention

Rice production grew at 6.0 percent annually between the first and second half of the 1970s (Table 1). This growth is primarily the result of the 5.2 percent annual increase in yields. Total area only grew at 0.8 percent annually. When growth in production is disaggregated into growth of area and yield for cropland types, it is clear that growth in yields on irrigated land has been the principal source of production increase, followed by growth in yields on rainfed land, and the increase in irrigated area.

Only a small part of yield growth is due to the first time adoption of modern varieties (MVs). Sixty percent of total rice area was already planted to MVs in the early 1970s and this increased somewhat to 72 percent by the late 1970s. Fertilizer use on rice grew from 27.7 kilograms to 37.7 kilograms NPK per hectare in the same period. If an additional kilogram of fertilizer produces 10 kilograms of paddy on average, then increased fertilizer use accounts for about one-third of the growth in yields.

Most of the yield increase is due to the improved productivity of newer MVs on both irrigated and rainfed land. The older MVs, IR8 and IR20, were responsive to fertilizer on irrigated fields, but were not resistant to pests and disease or tolerant of moisture stress. IR36, released in 1976, was the first short duration variety. It matures in only 110 days, compared with 135 days for IR8. This allows expanded double-cropping in irrigated and more favored rainfed environments, and thus contributed to increases in area. Furthermore, IR36 is resistant to insect pests and disease so that there have been no widespread crop failures since its introduction. IR42, released in 1977, and IR50, released in 1980, are tolerant to moisture stress and adverse soil conditions and therefore do well on rainfed farms. Newer MVs are more productive on farmer's fields because they mature early, are drought tolerant, and pest resistant (Appendix Table 1). Technical change in the form of improved varieties has been the principal source of growth in Philippine rice production.

The growth in supply led to a decline in net imports from 1960 to 1980, although trade and production fluctuated in individual years (Table 2). Supply remained roughly 5 percent short of self-sufficiency in the 1960s (Apiraksirikul, 1976), as production lagged behind population growth. The 20 percent decline in production from 1972 to 1974 due to pest and typhoon damage led to large imports. Imports then declined steadily after production recovered in 1974. As population growth slowed and production growth was uninterrupted, Philippine rice supply reached domestic self-sufficiency in 1977. Small but growing amounts of rice were exported between 1977 and 1982.

The importance of different price policy instruments has changed with the growth in production. During the 1960s the Rice and Corn Administration (RCA) usually purchased less than 2 percent of production (Table 2). Government market intervention primarily took the form of disbursement of

Table 2. Rice production, international trade, and government market intervention in the Philippines (000 mt rice).

Crop year	Production	Net imports	Procure-ments	Disburse-ments	Change in govt. stocks
1962/63	2578.6	256.2	156.5	366.0	46.7
1963/64	2497.9	299.9	26.4	311.6	14.6
1964/65	2596.4	569.2	2.1	402.3	169.0
1965/66	2647.2	108.2	22.9	252.9	-121.8
1966/67	2661.1	238.6	56.1	150.4	144.2
1967/68	2964.5	-40.3	151.6	29.6	81.7
1968/69	2889.1	-0.5	145.3	169.0	-24.1
1969/70	3401.7	*	50.1	60.1	-12.0
1970/71	3472.9	369.3	2.1	108.7	79.2
1971/72	3315.1	440.1	0.4	541.3	24.5
1972/73	2869.5	308.1	4.8	252.2	81.9
1973/74	3636.2	169.3	22.0	189.8	37.0
1974/75	3679.0	145.3	95.9	238.2	3.1
1975/76	4003.7	55.2	163.9	259.1	-40.0
1976/77	4196.5	15.6	273.9	198.8	90.6
1977/78	4481.7	-13.4	451.5	136.7	267.5
1978/79	4678.1	-38.0	423.1	74.7	183.7
1979/80	5093.4	-236.0	403.1	268.2	-121.5
1980/81	5020.0	-175.0	280.5	255.1	-149.5

Sources: Production data are from BAEcon.
Net imports are from procurements and disbursements are from NFA.

imports in consuming centers. The RCA was replaced by the National Grain Authority (NGA), now National Food Authority (NFA), in 1972. The NFA increased procurements, purchasing at least 5 percent of the increased production since 1977. With growing domestic supplies, the government's role in disbursement declined. The task is now to dispose of surplus production through exports and increased government stock holding.

Government Policy

Impact on Product Prices

The twin goals of Philippine rice policy are to provide remunerative prices for producers and to provide steady supplies of rice at stable prices affordable by low income households. Official floor and ceiling prices are announced that presumably reflect these goals. Two instruments are used to implement rice price policy: a government monopoly on international trade and domestic market operations in defense of official prices. The sucessful defense of official prices ultimately depends on international trade, since any deficit must be supplied through imports and any surplus disposed of through exports. Year-to-year changes in stocks have been small (Table 2), so that control of trade has been the principal means of controlling domestic supply and prices.

This section examines two issues. First, has government trade control caused domestic rice prices to diverge from world prices? World prices represent the social opportunity cost of rice to the domestic economy. Therefore it is of interest to measure how far policy has caused domestic price incentives to differ from social prices. Second, have government actions maintained domestic prices at official price levels? If official prices represent government goals, then a comparison of actual and official prices measures whether government has met its price policy objectives.

Since the Philippines has normally imported during the last 20 years, the impact of trade controls on domestic prices can be measured best by a comparison of prices in Manila, the principal port and consuming center, with CIF prices. The average nominal protection coefficient (NPC), defined here as the ratio of Manila wholesale prices to CIF unit values or Thai prices, is close to 1.00 for the period 1960 to 1980. Domestic prices have generally followed the trend of world prices in the last two decades (Table 3 and Figure 1), but tended to be above world prices in the 1960s and below in the late 1970s.The average NPC for 1960 to 1970 is 1.15 and declines to 0.99 for 1977 to 1981.

The control on imported quantities caused domestic prices to be above world prices in the 1960s, even though official ceiling prices were at or below world price levels. From 1964 to 1970 domestic market prices were above world prices. Only in 1962 and 1963 were imports sufficient to keep domestic prices below world prices. Therefore actual domestic market prices were usually above the ceiling price. Only in 1968 and 1969 were domestic supplies adequate to keep domestic prices close to the ceiling price.[1] Government-controlled imports in the 1960s were not usually large enough to hold domestic prices at either world or official levels, with the result that domestic prices favored producers slightly over consumers.

Table 3. Comparison of world and domestic rice prices (₱/kg).

Year	CIF (FOB) value	Thai FOB 35% brokens	Manila whole-sale	Retail ceiling price	Manila ÷ CIF	Manila ÷ Thai	Ceiling ÷ CIF	Manila ÷ ceiling	Central Luzon wholesale ÷ floor
1960	(0.28)	.20	.36	.36	1.29	1.80	1.29	1.00	1.16
1961	*	.20	.45	.36	-	2.25	-	1.25	1.37
1962	0.44	.40[a]	.41	.36	0.93	1.03	0.82	1.14	0.96
1963	0.50	.43[a]	.47	.36	0.94	1.09	0.72	1.31	1.00
1964	0.45	.44[a]	.57	.34	1.27	1.30	0.75	1.66	1.18
1965	0.44	.45[a]	.55	.46	1.25	1.22	1.05	1.20	1.14
1966	0.51	.53[a]	.67	.55	1.31	1.26	1.08	1.22	1.03
1967	0.58	.55[a]	.68	.59	1.17	1.24	1.02	1.15	1.08
1968	(0.63)	.57	.64	.59	1.02	1.12	0.94	1.08	0.97
1969	*	.55	.60	.59	-	1.09	-	1.02	0.97
1970	*	.65	.72	.59	-	1.11	-	1.22	1.02
1971	0.54	.55[a]	.91	.59	1.69	1.65	1.09	1.54	1.22
1972	0.85	.71[a]	1.15	1.07	1.35	1.62	1.26	1.07	1.20
1973	2.24	1.75[a]	1.31	1.33	0.58	0.75	0.59	0.98	1.07
1974	3.35	3.37[a]	1.97	1.86	0.58	0.58	0.56	1.06	1.17
1975	2.21	2.20[a]	2.08	1.90	0.94	0.95	0.86	1.10	0.96
1976	1.66	1.72[a]	1.99	2.02	1.20	1.16	1.22	0.99	1.05
1977	(2.06)	1.67	2.05	2.10	1.00	1.00	1.26	0.97	1.04
1978	(2.28)	2.35	1.96	2.10	0.86	0.83	0.92	0.93	1.03
1979	(2.02)	2.19	2.14	2.36	1.06	0.98	1.17	0.91	0.86
1980	(2.22)	2.91	2.29	2.51	1.03	0.79	1.13	0.91	0.90
1981			2.61	2.75				0.95	0.99
Average 1960-1970					1.15	1.32	0.96	1.20	1.08
Average 1971-1980					1.03	1.03	1.01	1.04	1.04
Average 1977-1981					0.99	0.90	1.12	0.93	0.96
Average 1960-1981					1.09	1.18	0.99	1.12	1.06

Sources: CIF (FOB) values are from Data Series on Rice Statistics in the Philippines (Table 11) for 1963-67 and 1971-73. Other years from NCSO. Thai FOB prices are from Rice Committee Board of Trade, Thailand Manila wholesale prices are collected by Central Bank. Ceiling and floor prices are from RCA/NFA. Central Luzon (Cabanatuan) wholesale prices are collected by BAEcon.

[a]Ten percent added as estimate of transport costs in order to approximate the CIF price,

Philippine production declined in 1972 and 1973 while world prices rose sharply due to global production shortfalls. The newly organized NGA implemented rationing and subsidized imports in 1973-75 (Apiraksirikul, 1976). Even though domestic prices rose above ceiling prices in 1974-75, they were still 40 percent below world price levels. Domestic prices followed the rising trend of world prices but a combination of subsidized imports and domestic rationing were sufficient to buffer domestic prices from the abnormally high world prices in 1974.

Since 1976, supplies have been adequate to keep domestic consumer prices below ceiling prices and to export substantial quantities in 1980 and 1981. Domestic producer prices have now fallen below the official floor price, so that price policy implementation now favors consumers over producers.[2] The relationship of domestic prices to world prices is unclear. Domestic prices have been about equal to export unit values since 1977, but have been below Thai FOB prices for comparable quality (Table 3).

Low quality exports in 1979 and 1980 were sold at prices well below the Thai spot price. In spite of these low prices, considerable government stocks accumulated that could not be exported. Furthermore, the government reportedly lost P90 million in export subsidies between 1977 and 1979 (Business Day, July, 1982), in part becuase rice was separated and graded to meet quality standards.

There is an apparent contradiction between an NPC of 1.0 or less and the existence of export subsidies and unexportable surpluses. There are two reasons for this contradictory evidence regarding Philippine export capability. First, it seems likely that the world market cannot absorb low quality Philippine exports at the Thai 35 percent brokens price. In general world demand for low quality rice is less elastic than demand for high quality rice. Recently the world market for low grade rice may have been softer than usual. Indonesia has been the steadiest buyer of low grade rice (Somboonsup, 1975), but Indonesian imports dropped sharply from over 2 million tons in 1980 to one-half million in 1981 (USDA). World demand for low quality rice is not perfectly elastic for Philippine exports, and the marginal export price is lower than the Thai spot price.

The second and most important reason for the poor profitability of exports is the insulation of domestic markets from world market standards. The quality factors that determine prices on world markets differ from those that determine prices in domestic markets. Most domestic rice has between 25 and 45 percent brokens, but this percentage is not an important determinant of price (IRRI, 1970). On world markets, however, the price of 35 percent brokens varied from 61 to 13 percent below the price of 5 percent brokens during the 1970s.

Because exports are controlled by the government, world quality premiums are not reflected in domestic prices. The domestic milling industry therefore has no incentive to become competitive in higher quality international markets. The result has been subsidies for high quality exports and build-up of government stocks. These interventions have raised prices above what they would have been under autarky, but they are an expensive way of disposing of the domestic surplus. If private exports were allowed, world quality premiums would be reflected in domestic prices and Philippine exports could become competitive on world markets. This would reduce the cost of maintaining producer incentives.

In summary, the achievement of price policy objectives, as measured by official prices, has been fairly successful, but quantities imported or exported have usually been inadequate to completely hold official prices. Thus actual retail prices were above ceiling prices in importing years and producer prices were below floor prices in exporting years. Government control of trade in the current period of domestic surplus reduces quantity traded through reducing domestic incentives to produce high quality rice for export.

Domestic rice prices have followed the long-run trend of world prices. Government actions have insulated domestic markets from the variability in world rice markets, without introducing any permanent, major distortion in prices. The NPCs do show a shift from a slight producer bias in the 1960s to a slight consumer bias in the late 1970s, probably due in part to the changing costs of implementing policy. Maintaining ceiling prices has become less costly as domestic supply has grown while it has become increasingly expensive to maintain floor prices because of limited opportunities for profitable exports.

Impact on Input Prices and Value Added

The domestic price of rice has been declining relative to world prices since 1978. The net effect of government policies on producer incentives, however, also depends on the prices of production inputs. Government expenditures on irrigation, credit, and fertilizer increased sharply in the early 1970s in response to the crop failures in 1972 to 1974. The goal of these expenditures was to increase production through encouraging further adoption of the new rice technology. Fertilizer and credit policies became less favorable to producers after domestic production recovered. This section examines the recent history of government policies with respect to inputs and measures the effective rate of protection for rice production.

Irrigation: Irrigation investments increase the potential productivity of land, not only because irrigation allows control over water and double cropping, but because it is complementary to the use of fertilizer. National average yields are .6 tons higher on irrigated land than on rainfed land. The difference is more dramatic among Central Luzon farmers surveyed by IRRI in 1979. Irrigated farms obtained 1.2 tons more rice in the wet season, plus an additional 2.5 tons of production in the dry season. Thus irrigation has a substantial impact on potential yield and private returns.

Annual government expenditures for irrigation grew at 40 percent annually between 1965 and 1980, from P4 million to P1,972 million.[3] The cost of irrigation investment per hectare has been rising as more difficult projects are undertaken. Kikuchi and Hayami (1978; 1982) estimate that the cost per new hectare irrigated rose from an average of P847 in the 1960s to an average of P2884 in the 1970s. Irrigation costs per hectare have been rising at 10 percent annually during the 1970s.

The government bears all irrigation investment costs and some operating costs. Official irrigation fees in the Philippines are P374 per hectare and actual collection is somewhat lower (Appendix table 2). For gravity diversion, the most common system in the Philippines, the value of collected fees is only 14 percent of the annual costs of irrigation per hectare, and thus the subsidy is 86 percent (Table 4).[4] Government subsidies for irrigation substantially increase private profitability for farmers with irrigated land, both directly through reduction of private costs and indirectly through the increase in potential yields.

Fertilizer: Use of inorganic fertilizer is an important component of the new rice technology. Central Luzon farmers surveyed in 1979 applied 57 to 92 kilograms of nitrogen per hectare and fertilizer accounted for 20 percent of the variable costs of production. Hence the fertilizer price can be expected to have an important influence on production and profits.

Government fertilizer policy in the 1970s has attempted to serve the conflicting goals of providing incentives to the domestic fertilizer industry to promote self-sufficiency while also providing cheap inputs for food production. From 1973 to 1975 a two-tier price system was implemented to insulate food producers from high world fertilizer prices. A subsidy was paid to fertilizer producer/importers to cover losses, and fertilizer was distributed through the government credit program at roughly half the world price.

In 1976 world fertilizer prices dropped and fertilizer prices were unified domestically. A cash subsidy continued to be paid to domestic fertilizer producers to reimburse them for selling fertilizer at official prices. Other authors (David and Balisacan, 1981; Te and Herdt, 1982) have shown that producers pay fertilizer prices at or above world levels and the subsidy accrues to fertilizer manufacturers. Farmers paid an average implicit tariff of 23 percent on urea and 44 percent on ammosul in 1978 (Table 4).

Table 4. Implicit tariffs on rice production inputs, Philippines, 1978.

Input	Implicit tariff[a/] (percent)
Urea[b/]	23
Ammosul[b/]	44
Insecticides and herbicides[d/]	28
Irrigation, gravity diversion system[c/]	-86
Irrigation pump system, 6" Ø axial flow[d/]	20
Hand tractor, 10 hp[d/]	30
4-wheel tractor, 75 hp[d/]	10
Portable thresher, axial flow[d/]	10
Large axial flow thresher[d/]	10
Fuel and lubricant[d/]	21

[a/] Farmer's price divided by border price adjusted for transport costs, minus one.

[b/] Urea and ammosul are average implicit tariffs for 1978, 1979, 1980 calculated from the percent difference between domestic and border price (see David and Balisacan, 1981).

[c/] See Appendix Table 2.

[d/] Based on legal tariff rates.

Thus fertilizer subsidies since 1976 benefit the domestic industry rather than farmers.

Credit: In order to adopt new technology, large cash outlays are needed that are normally financed through loans. Various government programs in the 1950s and 1960s provided subsidized credit to farmers through rural banks and government cooperatives (see Bouis, 1982 for a review of these programs). The amount of formal credit for rice production increased steadily during the 1960s and Mears, et.al., (1974) report that in the late 1960s formal sources of credit accounted for a third of total production credit in Central Luzon.

The current government credit program, Masagana-99 (M-99), was launched in 1973. The loan consists of a package of recommended amounts of inputs such as fertilizer and insecticides as well as cash. The annual interest on M-99 loans is 14 percent, substantially below both informal market rates and the commercial rates of 21 to 25 percent.

The M-99 program increased formal credit for rice production from a base of P300 million in 1970 to P716 million in 1974 when 800,000 farmers participated. Due to repayment difficulties program lending declined to P196 million in 1979, less than the pre-program level. Although 61 percent of Central Luzon farmers borrowed to meet production costs in 1979, only 18 percent received M-99 loans. Thus it seems that the M-99 program provided a one-time transfer of income to farmers to help overcome the effects of the 1974 production shortfall. The apparent decline in the importance of formal credit is supported by David (1982), who reports that total agricultural production loans have declined as a percent of total loans and as a percent of agricultural value added since 1970. Because M-99 reaches a small percentage of rice farmers, subsidies on credit are not considered in the following analysis of incentives.

<u>The Effective Protection Rate</u>: The impact of government policy on value added or returns to domestic factors of production is measured by the effective protection rate (EPR). The EPR is the ratio of value added in domestic prices to value added in world prices, minus one. Government subsidies on irrigation investment and operation are the only way in which policies increase private profitability in rice production. Other price policies do not favor rice producers, as the price of fertilizer, insecticides, machinery and fuel are all higher than border prices (Table 4). These policies are reflected in the difference between EPRs for rainfed and irrigated systems (Table 5). The EPR for rainfed systems is -4.7 percent and is less than the NPR of -2.0 for 1979. Government input price policies further reduce incentives for rainfed farms and there are no benefits from the irrigation subsidy on these farms. Irrigated systems have slightly positive protection of 3.6 percent, showing that irrigation subsidies more than offset the negative effects of low input and product prices.

Incentives for rice producers have declined in the late 1970s, but these distortions in incentives are relatively small compared to other distortions in the economy. The EPRs for rice are very close to zero, and thus growth in production has occured without any gross distortions in net incentives. Government policies have favored irrigated producers slightly and have increased irrigated area. Other government price policies have taxed producers to benefit consumers and domestic manufacturers of agricultural

Table 5. Estimates of effective protection rate on rice production, Central Luzon, 1979 wet season.

Type of cropland	System[a]	Power source for: Land preparation	Power source for: Threshing	Effective protection rate (%)
Rainfed	1	Animal	Manual	-4.6
	2	Animal	Machine (tilyadora[b])	-4.9
Irrigated				
One-rice crop	3	Animal	Manual	4.9
	4	Animal	Machine (tilyadora[b])	4.8
Two-rice crop	5	Tractor	Manual	2.7
	6	Tractor	Machine (small axial flow)	2.6
	7	Tractor + animal[c]	Manual	3.5
	8	Tractor + animal[c]	Machine (small axial flow)	3.3
Average:				
Rainfed				-4.7
Irrigated				3.6
Overall				1.5

[a] One-crop irrigated and rainfed farms tend to use animals for land preparation but most two-crop rice farms use tractors because they reduce the turnaround time between crops. It is equallly common for threshing to be done manually or by large machines on rainfed and one-crop farms. Two-crop farms thresh by hand or with small axial flow threshers because of the difficulty of bringing large machines into the wet fields between crops (Cordova et.al. 1981).

[b] Large mechanical thresher.

[c] Tractors for primary tillage, plowing or rotovation and animal for final harrowing before transplanting.

inputs. In spite of these unfavorable prices, yields and production have continued to grow in all environments because of continuing improvements in rice varieties.

Social Profitability in Rice Production

Rice production is socially profitable if the social cost of domestic factors used in production is less than the foreign exchange earned. The domestic resource cost ratio (DRC) measures the value of domestic resources needed to produce one dollar's worth of rice. It is the ratio of domestic factor costs to value added in world prices. When the DRC is less than the shadow exchange rate, the activity is socially profitable.[5]

All the Central Luzon rice farming systems are socially profitable in 1979 (Table 6). The estimated DRCs are below the shadow exchange rate of P8.856 per US dollar.[6] Differences in the DRCs among production systems are not large. Rice production on irrigated farms is a slightly more efficient foreign exchange earner than production on rainfed farms, because the higher yield on irrigated farms results in a lower production cost per unit of rice. Rainfed systems are quite competitive socially with irrigated systems, however, because their costs are lower. The decrease in yield between irrigated and rainfed farms is 45 percent, but the increase in the average DRC from 6.52 to 6.86 is only 5 percent.

A comparison of these results with the Herdt and Lacsina (1976) estimate reveals how technical change has altered comparative advantage in the 5 years from 1974 to 1979. They estimated social profitability for Central Luzon farms using both tractor and carabao for land preparation and large scale

Table 6. Summary of domestic resource cost components in rice production, eight systems, Central Luzon, 1979 wet season.

System	Yield, milled rice[a] (mt/ha)	Production costs[b] Domestic (₱/mt)	Production costs[b] Foreign (₱/mt)	Mktg. cost[c] (₱/mt)	Domestic resource costs[d] (₱/US$)	Critical minimum world price[e] (US$/ton)
Rainfed						
1 Animal/Manual	1.31	1,539	227	268	6.94	205
2 Animal/Machine	1.31	1,451	277	268	6.78	201
Irrigated one-crop						
3 Animal/Manual	2.42	1,477	290	268	6.93	209
4 Animal/Machine	2.42	1,389	316	268	6.68	202
Irrigated two-crop						
5 Tractor/Manual	2.57	1,326	379	268	6.65	204
6 Tractor/Machine	2.57	1,237	407	268	6.38	197
7 Mixed/Manual	2.57	1,344	335	268	6.56	200
8 Mixed/Machine	2.57	1,254	363	268	6.29	193

[a] Based on a milling recovery rate of 0.65.

[b] See Appendix Tables 3 and 4.

[c] 25% of ex-farm prices.

[d] Based on F.O.B. price of $291/mt, the average export unit price for the period 1978-1980; official exchange rate of ₱7.38/US$.

[e] At which DRC equals shadow exchange rate of ₱8.856/US$.

threshing machines. Production system 8, using mixed power for land preparation and small scale threshers, is the most comparable system in 1979. Production costs per hectare for most activities increased between 1974 and 1979 as the costs of most tradeable inputs and factors increased (Table 7). At the same time the price of rice fell on world markets, so that a decline in the DRC might have been expected.

DRCs calculated at the 1979 world price for both 1974 and 1979 indicate a substantial increase in comparative advantage over the five year period. This is due to the growth in yields from 2.00 tons to 2.57 tons milled rice per hectare, which sharply reduced social production costs per unit of rice output. Herdt and Lacsina assumed a 2.0 ton yield even though yields in 1974 had only reached 1.8 tons, because 2.0 tons seemed feasible in the future. Growth in actual yields has far exceeded expectations. In only 5 years comparative advantage has increased substantially due to technical change in the form of improved rice varieties.

This comparison highlights the importance of changes in world price, yields, and costs in determining comparative advantage. The world rice market is notorious for price variability and it is therefore of interest to determine the price at which domestic costs would just equal foreign exchange earned. The world price must drop below \$210, \$80 less than the average 1978-80 price of US\$291 per metric ton, before the country loses its comparative advantage in rice (Table 6). Rainfed rice farming remains socially profitable at prices only slightly higher than the break-even point for irrigated farming. World prices fell to \$240 in 1982, and have since recovered to \$260. It seems unlikely that world prices would drop below \$210

Table . Changes in social costs and returns in rice production.

	1974[a]			1979[b]		
	Foreign	Domestic	Total	Foreign	Domestic	Total
Seed		88	88	109	37	146
Land preparation	83	143	226	95	322	417
Irrigation	366	653	1019	288	575	863
Fertilizer	177	68	245	257	37	294
Chemicals	29	29	58	111	16	127
Pre-harvest hired labor		205	205		205	205
Interest	66	119	185		154	154
Threshing and harvesting	35	258	293	72	476	548
Family labor		225	225		344	344
Land rent		800	800		1058	1058
Total costs per hectare	756	2588	3344	932	3224	4156
Yield[c]			2.00			2.57
Cost/ton	378	1294	1672	363	1254	1617
Marketing	6	484			268	
World price ($/ton)			$350			$291
DRC[d]						
at respective world prices			6.02			6.29
at 1979 world price			7.44			6.29

Sources: Herdt and Lacsina (1976) and Table 6, Appendix Table 4.

[a] Tractor and carabao used for land preparation. Threshing by tilyadora

[b] Tractor and carabao used for land preparation. Threshing by small axial-flow machine.

[c] Tons milled rice per hectare.

[d] Foreign costs converted at official exchange rate of ₱7.0/US$ in 1974 and ₱7.4/US$ in 1979.

in the long run, and thus Philippine comparative advantage is quite robust with respect to world price.

Changes in yields and costs affect the social profitability of producing the marginal increment of rice. Continued growth in domestic demand will raise domestic prices above world prices unless there is further growth in production. If additional growth in production is not socially profitable, the country will lose its comparative advantage. There are two ways in which additional rice can be produced if yields do not continue to grow. Additional rainfed lands can be brought into production or additional investments in irrigation can raise yields. It is useful to consider the social costs of increasing rice output in these two ways.

Rainfed rice production in Central Luzon is only marginally privately profitable. Returns to family labor in rainfed systems are less than the market rate for hired labor. Even though rainfed land in Central Luzon is more productive than in some other regions, labor costs in Central Luzon are higher. Thus these farms can be viewed as representative of the marginal Philippine rice farm. As rainfed systems are socially profitable in Central Luzon, additional production on rainfed lands is likely to be socially profitable. Recent growth in yields on rainfed land has increased social profitability for this environment as well as for irrigated land. Increased production from this environment is now socially competitive with increases from irrigated systems.

Irrigation investment costs are rising in the Philippines because additional areas are more difficult to irrigate. Hence the cost of obtaining more production through expansion of irrigated area is rising also. Kikuchi

(1982) estimates that capital costs per new hectare irrigated rose to P6660 in 1980. If this cost is annualized over 30 years and operations costs are added, the cost of irrigation is P1225 per hectare, much greater than the P863 used to estimate the 1979 DRC. This higher irrigation cost raises the DRC to 8.06, so that rice production remains socially profitable. Continued growth in irrigation costs, however, could quickly erode Philippine comparative advantage.

The comparison between 1974 and 1979 showed the importance of yield growth in reducing social costs per unit of output. Further yield growth can offset the rising cost of irrigation investment. If irrigation costs continue to grow at 10 percent annually and other costs remain constant, yields will have to grow at least 2.8 percent annually to maintain current social profitability.

Conclusions

Philippine rice production has grown rapidly in the 1970s and the country now has an exportable surplus. Growth has been due primarily to yield increases from newer modern varieties. Rice varieties released since 1976 are more productive in all environments because they are pest and disease resistant and more tolerant of moisture stress.

Growth in production has been achieved without gross distortions in production incentives. Government policies have contributed to growth principally through investments in irrigation. Irrigation costs are heavily subsidized but other price policies reduce producer incentives. Domestic rice prices are slightly below world prices and most inputs are taxed. Policies thus favor irrigated farms over rainfed farms.

Technical change in Philippine rice production has increased yields and reduced factor costs per unit of output, thereby increasing comparative advantage. Rice production is socially profitable in 1979 in both rainfed and irrigated environments. Future comparative advantage in irrigated environments will depend on the relative growth of yields and irrigation investment costs as more costly irrigation projects are undertaken. Rainfed rice production seems to be socially competitive with irrigated production, so there may be scope for expansion of rainfed areas instead of irrigation investment.

Although the Philippines has a comparative advantage in rice, exports were unprofitable for the government marketing agency in 1977 to 1979. Two factors account for the losses on exports. Government control of exports puts a barrier between domestic markets and world market quality standards so that export price incentives for quality are not passed through to domestic processors. Profitable exports are then limited by inelastic world demand for low quality Philippine rice.

In order to exploit the country's comparative advantage in rice and maintain producer incentives, it is necessary to develop higher quality processing to meet world standards. Thailand produces high quality rice with similar milling technology and additional cleaning, sorting, and grading. The costs of these activities need to be ascertained and compared with the quality premium paid on world markets, but unfortunately the present study was unable to obtain the cost information. A rough estimate of the quality premium is the difference between the Thai 5% price and FOB unit values for Philippine exports. This difference averaged $64 per ton in 1977 to 1980. Because total milling costs in the Philippines averaged only $10 to $25 per ton in 1978 (IRRI,1978), it seems likely that the additional costs of sorting and grading would be less than the premium.[7] Thus if private millers were allowed to export, they should be able to respond to world market incentives to produce and export good quality rice at a profit.

If the Philippines has small export surpluses in the coming years it is essential to provide incentives to domestic millers to produce better quality rice for export. With the security that a domestic surplus provides, it should be possible to open up exports to the private trade. This will reduce government costs, further exploit comparative advantage, and maintain producer incentives.

FOOTNOTES

1. Domestic prices remained above world levels in those years which would have induced imports in an open market. Instead, small quantities of rice were exported because the official price ceiling had been reached.

2. Part of the reason why both floor and ceiling prices do not hold at the same time is the narrow margin between official prices. This margin does not cover the private costs of trade. Government must replace some portion of private trade and subsidize marketing in order to hold official prices. See Unnevehr (1982) for a complete discussion of the costs and impact of marketing subsidies.

3. Different data sources give conflicting evidence about the rate of irrigated area expansion. NIA data show an increase of 6 percent annually between 1965 and 1980, while BAEcon data show an increase of 1.8 percent annually (PCARDD 1980; NIA, various years). It is likely that some portion of irrigation investment improved existing systems.

4. NIA operated gravity systems accounted for one-third of irrigated area in 1975 (Kikuchi and Hayami, 1978).

5. Land, labor, and the cost of capital services are domestic factor costs, and market prices are assumed to represent the social opportunity cost of these factors. Actual wages for hired labor are assumed to represent the social wage for both hired and family labor. Rent paid by share-tenants to landlords, about 25 percent of output after deduction of shared input costs, represents the shadow price of land. The estimated value of capital sevices is the annual depreciation of the border price replacement value of the capital asset plus 15 percent annual interest. Domestic transportation and handling are also counted as domestic costs. All tradable inputs are a foreign exchange cost and are valued at border prices. Non-tradable inputs, mainly irrigation, are decomposed into tradable and non-tradable components, using data from Moya (1981).

6. The shadow exchange is estimated at 20 percent above the official exchange rate of 7.38 in 1979 (Medalla, 1982).

7. This assumes that discarded brokens have some economic value. In Thailand brokens are sold to the animal feeding industry.

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Appendix Table 1. Characteristics of commonly grown improved varieties.

Variety	Year of release	Growth duration	Disease resistance	Insect resistance
IR8	1966	135	S	S
IR20	1969	130	MR	S
IR36	1976	110	R	R
IR42	1977	140	R	R
IR50	1980	105	R	R
IR52	1980	115	R	R
IR56	1982	110	R	R

S = susceptible

MR = moderately resistant

R = resistant

Appendix Table 2. Estimates of government subsidy on national and communal gravity irrigation systems, Central Luzon, 1980 prices.

	National[a]	Communal[a]
1. Annualized capital investment cost (₱/ha)[b]	667	812
Operation and maintenance cost (₱/ha)	211	77
Total annualized cost (₱/ha)	878	889
2. NIA-charged irrigation fee		
Palay (cavans/ha)[c]	7.0	7.0
Value[d] (₱/ha)	374	374
Actual NIA collection[e]		
Palay (cavans/ha)	2.24	1.40
Value (₱/ha)	120	75
3. Percent subsidy on gravity irrigation based on:		
NIA - charged irrigation fee	57	58
Actual NIA collection	86	92

[a] With reference to San Fabian River Irrigation System for national gravity system and to an average of four communal gravity irrigation systems in Central Luzon for the communal system.

[b] Based on 15% interest rate, 60 years life span per dam, 30 years for canal, and 15 years for pump and engine. Initial figures are based on Moya (1981).

[c] 2.5 cavans/ha for wet season and 3.5 cavans/ha for dry season.

Appendix Table 3. Farmer's costs of rice production in Central Luzon, eight systems, 1979 wet season.

System	Total	Seed[a]	Land preparation[b]	Irrigation[c]	Fertilizer[d]	Insecticides and herbicides	Other pre-harvest hired labor[e]	Total pre-harvest costs	Interest on pre-harvest costs[f]	Harvesting and threshing[g]	Family labor[h]	Land rent[i]
	Pesos per hectare											
1	2,337	106	490		225	51	205	(1,077)	31	359	282	538
2	2,265	106	490		225	51	205	(1,077)	31	287	282	538
3	3,537	109	490	120	328	113	205	(1,365)	102	564	410	996
4	3,404	109	490	120	328	113	205	(1,365)	102	531	410	996
5	3,738	112	554	120	367	159	205	(1,517)	114	705	344	1,058
6	3,597	112	554	120	367	159	205	(1,517)	114	564	344	1,058
7	3,626	112	450	120	367	159	205	(1,413)	106	705	344	1,058
8	3,485	112	450	120	367	159	205	(1,413)	106	564	344	1,058

a/ Valued at 150% of palay price received.

b/ For tractor (2-wheel) operated farms, initial land preparation costed ₱250/ha; for harrowing, ₱304/ha. Animal-operated farms required 24.5 man-animal days (14.5 and 10 MAD for initial land preparation and harrowing, respectively), valued at ₱20/MAD.

c/ NIA - charged irrigation fee of 2.5 cavans/ha, wet season.

d/ Data source gives only total fertilizer costs. Assumed to be all urea.

e/ Other than hired labor for land preparation.

f/ At 15% per annum, apportioned as original cost; for six months, 7.5%.

g/ For manual threshing and harvesting, 1/6 of yield; harvesting alone, 1/12 of yield; machine threshing, a custom fee of 5% of yield. All shares valued at ₱1.07/kg.

h/ Does not include operator's and family labor used in land preparation and threshing and harvesting. Family labor used in the latter were valued and entered like hired labor in these operations.

i/ 25% of yield, valued at ₱1.07/kg.

Appendix Table 4. Allocation of rice production input costs to domestic and foreign sources, fully traded assumption, eight systems, Central Luzon, 1979 wet season.

Source of cost/ system	Total	Seed	Land prepa- ration	Irri- gation	Ferti- lizer	Insecticides and herbicides	Other pre- harvest hired labor	Total pre- harvest costs	Interest on pre- harvest costs	Harvest- ing and threshing	Family labor	Land rent
						Pesos per hectare						
Domestic												
1	2,016	35	490		23	5	205	(758)	79	359	282	538
2	1,901	35	490		23	5	205	(758)	79	244	282	538
3	3,574	36	490	575	33	11	205	(1350)	154	664	410	995
4	3,362	36	490	575	33	11	205	(1350)	154	452	410	996
5	3,407	37	271	575	37	16	205	(1141)	159	705	344	1,058
6	3,178	37	271	575	37	16	205	(1141)	159	476	344	1,058
7	3,453	37	322	575	37	16	205	(1192)	154	705	344	1,058
8	3,224	37	322	575	37	16	205	(1192)	154	476	344	1,058
Foreign												
1	297	103			158	36		(297)				
2	363	103			158	36		(297)		33		
3	703	106		288	230	79		(703)				
4	765	106		288	230	79		(703)		62		
5	975	109	210	288	257	111		(975)				
6	1047	109	210	288	257	111		(975)		72		
7	860	109	95	288	257	111		(860)				
8	932	109	95	288	257	111		(860)		72		